



High voltage products

PASS Family

Plug and Switch System

PASS M00, PASS M0, PASS M0S

Power and productivity
for a better world™



Focus factory

The ABB Focus Factory based in Lodi, Italy, is one of the facilities belonging to the ABB Group. It produces High Voltage electrical equipment on a covered area of more than 12,000 square metres.

It is a Global Focus Factory, and a centre of excellence for design and production of high voltage hybrid circuit-breakers and switchgear. A market leader, it exports approximately 80% of its products worldwide.

The factory is organized according to “Lean Production” criteria and is managed by means of an integrated ERP system. The Quality System conforms to ISO 9001 standards, the Environmental Management System to ISO 14001 standards, and the Health and Safety Management System to OHSAS 18001 standards.

Both quality and environmental management systems are certified by DNV (SINCERT accredited).



Laboratories

ABB plant has internal laboratories equipped with state-of-the-art equipment in order to carry out material, experimental, climatic, mechanical life, electromagnetic compatibility, commissioning and dielectric tests. Type and routine tests ascertain whether the components, construction stages and finished products comply with the strict specification requirements. The Test Laboratory is accredited by an external independent organization and complies with UNI CEI EN ISO/IEC 17025 Standards.



Production

The idea behind new plant of Lodi was that the development process for new products must always be flanked by an adequate and coordinated process for handling the physical and computerized flows. To respond to the demands from the market in the best possible way, it is consequently also essential to plan the internal logics of the processes and synchronize the flows. Criteria to achieve standardized and common components are followed right from the time that new products are engineered in order to comply with the need to coordinate the operating flows. This makes supplies of materials, the assembly processes and the general production planning and programming process more fluid, speeding up



the phase in which the products pass through the plant and enabling ABB to achieve a much more flexible response to the demands from the market.

To synchronize the physical flows, particular attention has been paid to ensure that modern process techniques are applied, namely: Just in Time, Lean Manufacturing and Theory of Constraints. Use of these new techniques in the factory has achieved sensible considerable improvements, such as:

- a shorter throughput time;
- a lower inventory value;
- less space required in both the storage and production departments;
- total quality.

The ATO model (Assemble To Order) has been implemented for management purposes, so assembly work can only begin once the order has been acquired. Although an extensive mix of finished product codes can be manufactured with certain standard sub-assemblies in common, the management model limits the stocks of semi-processed parts, subassemblies or finished products to the WIP (Work In Progress) at the given time.

The layout of the new plant is based on flows and no longer on single stations. This has saved a great deal of space and has improved and safety and quality of the work to a considerable extent. The logic by which the components are fed to the lines was modified at the same time, bills of materials were organized differently so as to pilot the supplies of components for each individual assembly phase.

Service

Thanks to its Service structure, the ABB plant provides a full after-sales service for its customers' needs: analysis and modification of existing installations, diagnosis of module conditions, solutions for reducing life cycle costs, upgrading to achieve compliance with Standards and laws, retrofitting and revamping interventions, training and updating of maintenance personnel, as well as emergency interventions.



Introduction

The Hybrid Switchgears

The arrival of the newly created PASS MOS switchgear for voltages up to 252 kV has enlarged the PASS family: ABB's hybrid "Single-Phase, Encapsulated Plug And Switch System" solution. Starting with voltages of up to 100 kV with PASS M00, through PASS M0, which can be used for voltages up to 170 kV and then to the above-mentioned PASS MOS used for voltage values up to 252 kV, almost all the transmission and distribution voltage levels can be served by PASS modules. The term "Hybrid" refers to the combination of both conventional air insulated switchgear (AIS) and the newer SF₆ metal-clad insulated switchgear (GIS), which takes advantage of the two different technologies. The Hybrid switchgear solution uses already existing, tried-and-tested gas insulated switching components but also a conventional

and very reliable AIS bus to connect the various hybrid modules.

All the functions (except the ring type current transformers) are sealed in a single SF₆ gas insulated housing:

- circuit-breaker;
- disconnectors;
- earth switches;
- cable sealing ends;
- fast earthing switches;
- SF₆ VTs or voltage sensor.

PASS could also be called "Performance And Save Space" as it is possible to obtain any substation layout by making efficient use of the available space.



PASS M0 145 kV SBB

Advantages

PASS combines all the typical functions of a complete AIS bay for electrical substations with voltage ratings of up to 252 kV in a unit with a volume is comparable to that of a conventional circuit-breaker of equal class.

It takes advantage and widens the scope of the operating philosophy of the PASS series whose dominating factors - those that have dictated the product's success with more than 6500 systems sold throughout the world - are briefly outlined below:

1. Relatively inexpensive AIS bus bar:
 - yet traditionally highly reliable.
2. All live contacts in SF₆:
 - experience has shown that AIS disconnect switch contacts require relatively high levels of maintenance whereas the experience with GIS has been exactly the opposite;
 - SF₆ technology means less ongoing maintenance;
 - highly reliable equipment leading to a lower global life cycle cost.
3. Fewer switching elements:
 - use of highly reliable GIS style switches allows the switching elements to be rationalized.
4. Pre-tested in the Factory, also for earthquakes.
5. Competitive installation cost:
 - time on site minimized;
 - less risk of delay due to adverse site conditions;
 - less demand for skilled resources at site.
6. High degree of factory assembly:
 - higher quality finished bay than one assembled under on-site conditions.
7. Facilitates monitoring / on-line diagnostics:
 - integrated nature of the plant facilitates introduction of

electronic monitoring and on-line remote diagnostic analysis.

8. Modularization of the substations:

- savings during the design and construction stages;
- minimal variations using standardized components;
- less risk of design errors;
- greater confidence in project estimation as costs are predictable.

That means:

- very high reliability and availability of the substation;
- drastic reductions in the time needed to install the equipment;
- much less space required;
- simplified substation layout;
- less maintenance required (maintenance on demand);
- very good cost performance for purchasing, maintenance, operation, outage and relocation;
- environmentally friendly: recycling / disposal at end of life.

Versatile operation

PASS features versatile operation that knows no rivals in the field of high voltage components.

PASS offers a series of modules for HV substations:

- Single Bus Bar (SBB);
- Double Bus Bar (DBB);
- Double Circuit Breaker (DCB).

PASS can also be used as a high voltage bay on a mobile truck, available for emergencies or if work has to be carried out on already installed HV bays.



Quick and easy erection and commissioning activities

Components

Gas density control



Since the dielectric strength of the switchgear and the breaking capacity of the SF₆ circuit-breaker depend on the density of the SF₆ gas, a gas density relay is installed to control gas density and detect leakage.

Voltage transformer



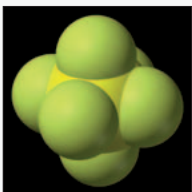
PASS can be equipped with conventional GIS inductive voltage transformers. Similarly to Current Transformers, several combinations of windings for protection and measurements with different loads are available.

Over-pressure relief



A rupture diaphragm (rupture disk) is installed for protection against excessive over-pressure due to internal arc faults. When a predetermined overpressure is reached, the rupture disk will break and relieve the pressure which would otherwise cause the enclosure itself to break. Deflectors in front of the diaphragms ensure the safety of personnel.

SF₆ Gas Insulated System



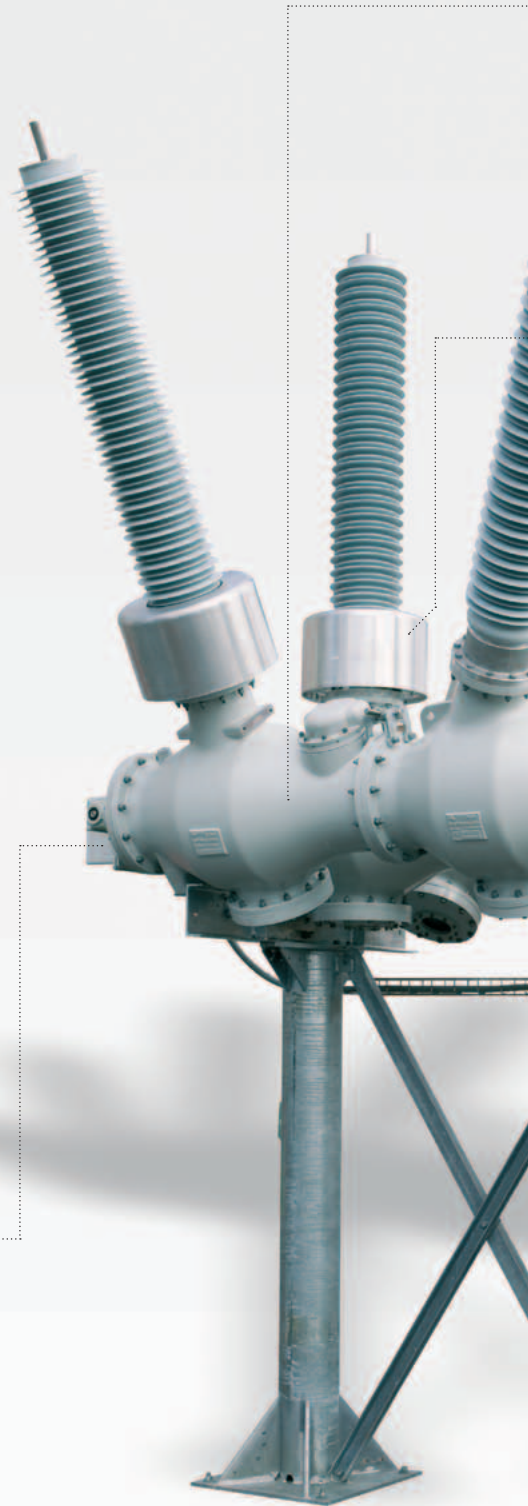
The compact design of the PASS module is due to the excellent insulation qualities of SF₆ gas. Its dielectric strength in a homogeneous field is about 2.5 times greater than that of air at the same temperature and pressure. The design of the live components is such that the distribution field is as homogeneous as possible, allowing the intrinsic strength of the insulating gas to be utilized more efficiently.

Combined disconnecter / Earthing switch



PASS is equipped with combined disconnecter/earthing switches. The mechanism has a minimal number of mechanical components, it is intrinsically reliable and maintenance-free. All required combinations are possible. In all PASS versions, the position of the combined disconnecter/earthing switch is clearly shown by an indicator mechanically coupled to the shaft.

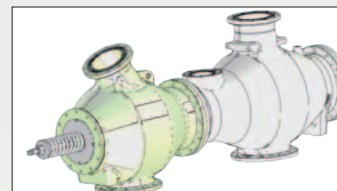
Moreover, visual confirmation can be obtained by means of an inspection window in the enclosure. The disconnecter/earthing switch can also be operated manually by means of a crank.





Circuit-breaker

The PASS circuit-breaker is a single-pressure interrupter that operates by means of the well-known self-blast principle. The energy for breaking currents is partly supplied by the arc itself, thereby reducing the energy the operating mechanism has to provide by about 50% compared with a conventional puffer type circuit-breaker.



Current transformer

PASS is equipped with conventional current transformers to meet customers' requirements. Several combinations of cores for protection and measurements with different loads are available. Up to 5 cores can be fitted into the current transformers.



Bushings

The insulator consists of an epoxy impregnated fiberglass tube with silicon rubber sheds. The main features are:

- high degree of safety (crack and explosion resistant);
- low weight;
- excellent pollution and rain performance;
- sandstorm-resistant;
- maintenance-free.



Circuit-breaker drive

BLK is the spring-operated drive for the circuit-breaker, designed with a minimum number of components.

BLK is available with 2 alternatives:

- BLK 82 intended for a single-pole operation in line-bays where single-phase auto-reclosing is foreseen^(*);
- BLK 222 intended for three-pole operation^(**).



^(*) For PASS M00 version, the BLK82 can operate as for three-pole mechanism.

^(**) For PASS M0S BLK222, it can operate as a single-pole mechanism.

Transport

No special arrangements are needed for shipping and transportation. PASS fits into a standard truck container and does not require any packaging. Once on site, a simple 30° rotation of the outer poles is required for the final layout of PASS. The picture shows PASS 245 kV in the DCB configuration in the transport position. Its compactness is self-evident.



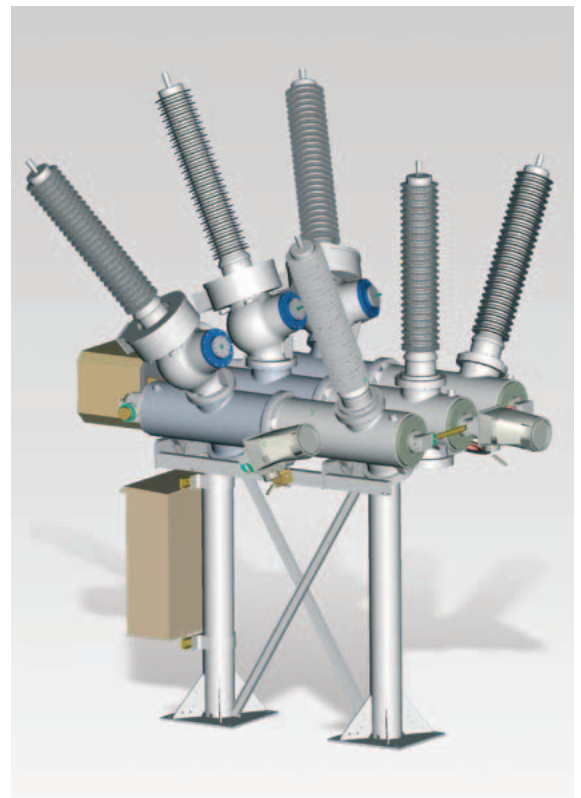
PASS M0

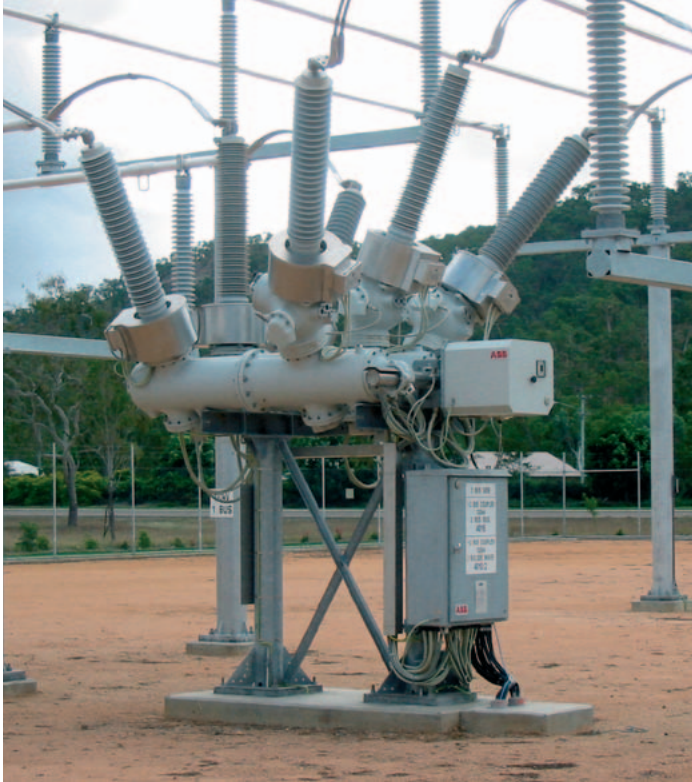


PASS M0 is the best seller of the family: PASS M0 was the first PASS designed (1999) and, thanks to its features (compact design, modularity and reliability), it was immediately accepted by the electrical market. Since then, more and more customers have decided to include PASS M0 in their Distribution Substation designs: the result is a reference list of more than 6500 equivalent bays energized around the world and in very different climatic conditions. PASS M0 has, in fact, been installed both in the desert (Saudi Arabia) and in the Arctic (Russia), indoors and outdoors, on the roof of buildings (Poland) and underground.

PASS M0 is extremely flexible and meets very different final customer requirements. It may therefore have the following configurations:

- Single Bus Bar (SBB);
- Double Bus Bar (DBB);
- In and Out Substation (IOS);
- Double Circuit Breaker (DCB).





Single Bus Bar, Australia



Double Circuit Breaker, Italy



Double Bus Bar, Norway



In and Out substation, Italy

PASS M00

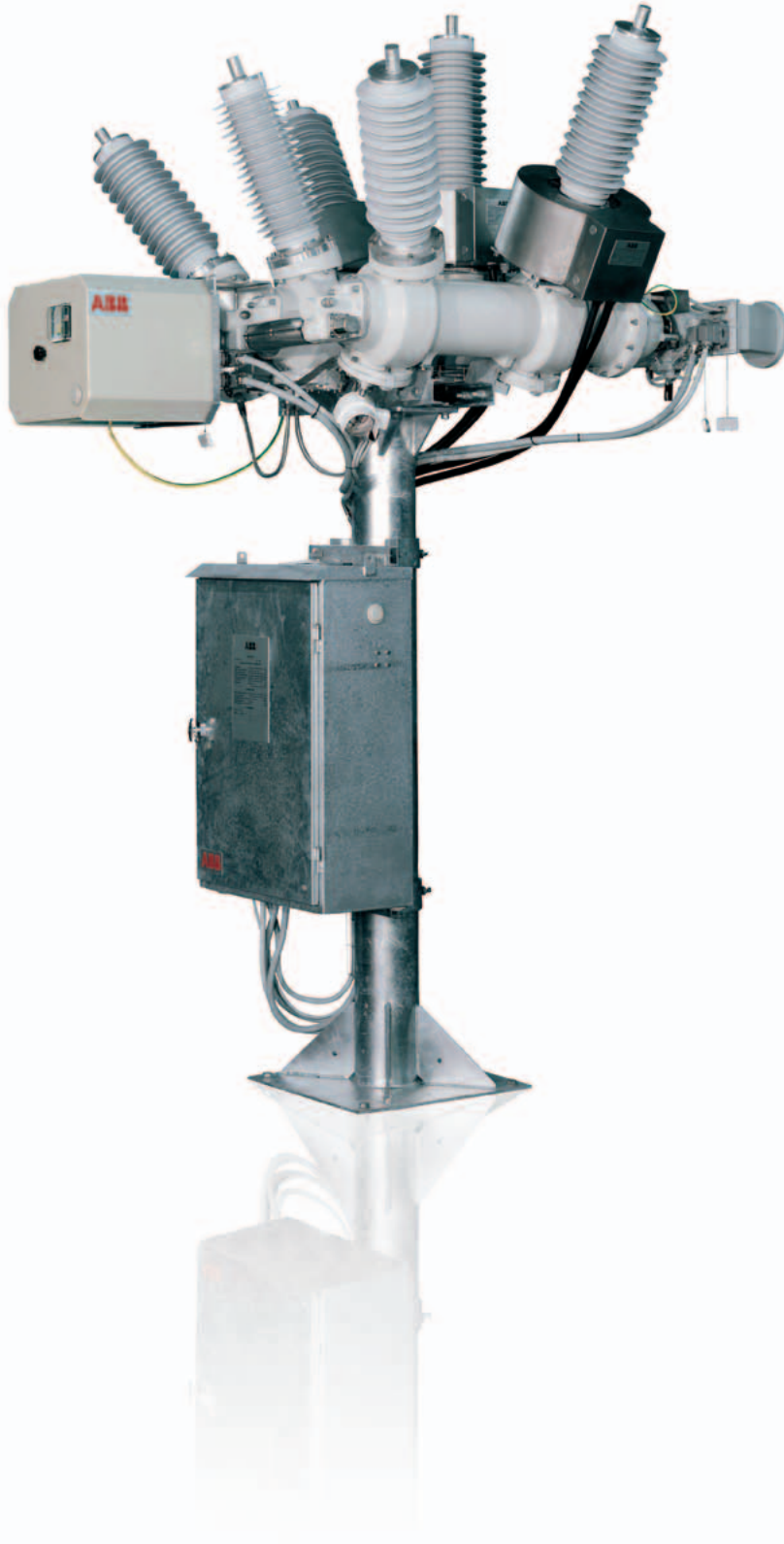


ABB designed PASS M00 in 2003 in order to meet the specific requirements of the fast-expanding market for 66 kV and 100 kV systems. In 2011 a completely new version was introduced, increasing the short-time breaking current up to 40 kV, and the maximum continuous current up to 3150 A. PASS M00 is smaller in size and weight than PASS M0 and boasts many innovative International Patents; the most important of these is the “Rotating breaking chamber” now also applied on PASS M0. In the rotating breaking chamber the disconnector and earthing switch moving contacts are installed directly on the enclosure of the circuit-breaker, which opens and closes the disconnector and earthing switches by turning.

All functions of a complete bay are included in one compact module. Thanks to its small size and low weight (comparable to a conventional “stand-alone” circuit-breaker), PASS M00 needs only one steel supporting tube. Therefore its installation is easy in both existing and new substations. Similarly to PASS M0, PASS M00 can also have different configurations:

- Single Bus Bar;
- Double Bus Bar.





Single Bus Bar, Italy



Double Bus Bar, France

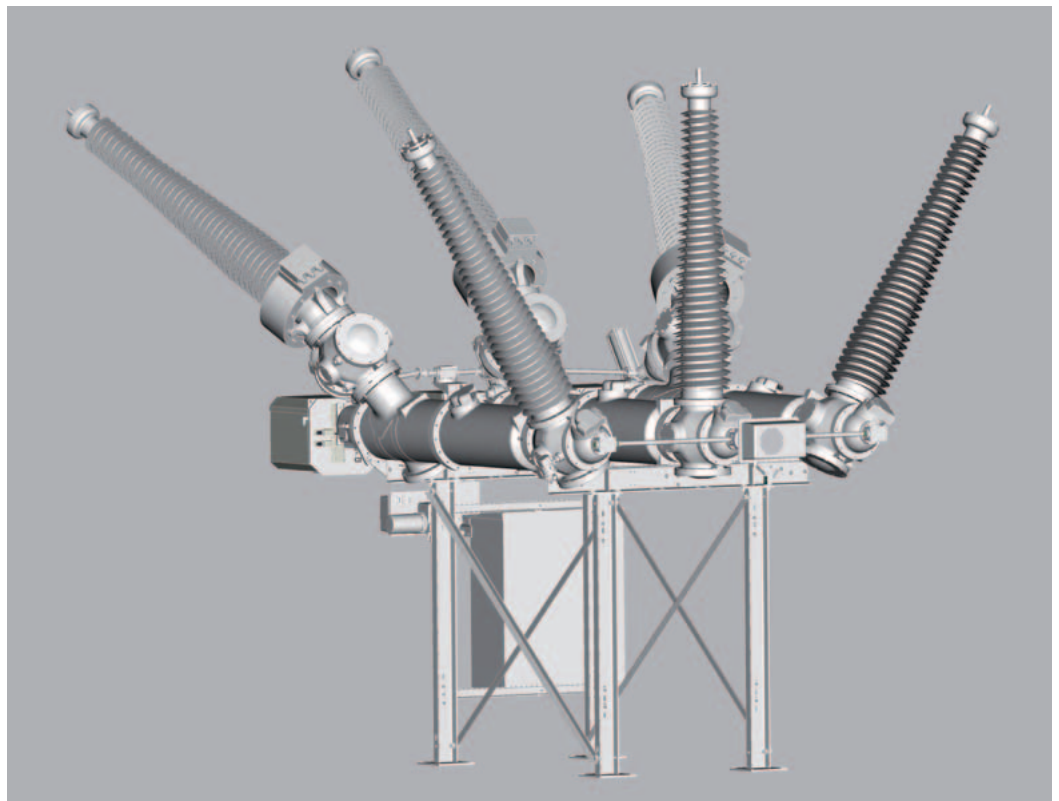


Single Bus Bar, Denmark

PASS MOS

245 kV - 40 kA

252 kV - 50 kA



PASS M0S is the latest arrival in the family and has been designed with all the PASS features in order to meet the market requirements up to 252 kV.

PASS M0S is fully designed, assembled and tested in the workshop, according to the PASS philosophy. In addition, PASS M0S can be transported completely assembled to the site. This means that no HV test need to be conducted on site after erection and commissioning, thus saving a time and money compared to all the other 245/252 kV switchgears (GIS, AIS or hybrid).

As usual, PASS M0S is extremely flexible and is available in the following configurations:

- Single Bus Bar (SBB);
- Double Bus Bar (DBB);
- In and Out Substation (IOS);
- Double Circuit Breaker (DCB).



M0S, Italy



M0S, Italy

MOSS

The Adda plant is ABB's leading centre for Mobile Substations, so ABB Adda is able to provide complete solutions for different customer requirements.

ABB Mobile Substations provide all the necessary functions for:

- restoring supply in case of emergency;
- routine maintenance in the case of single-transformer substation;
- facilitating projects by providing an alternative temporary supply in substations where maintenance and upgrading has to be conducted;
- covering periodical picks of load;
- industrial applications.

Thanks to extensive experience and know-how, ABB can provide a turn-key service that includes design and engineering of the MOSS, assembly, on-site testing and after-sales service.




For example, ABB can include the following equipment in a mobile substation:

- power transformer;
- PASS;
- voltage transformers;
- surge arresters;
- neutral earthing switches;
- auxiliary transformer;
- MV switchgear (AIS/GIS);
- Control and Protection with auxiliary supply unit.



25 MVA Mobile Substation, Russia

PASS Technical Data

							
		PASS M00		PASS M0		PASS M0S	
Rated voltage	kV	72.5	100	123	145	170	245 252
Frequency	Hz	50/60	50	50/60		50 60	50 60
Rated current	A	3150		3150		3150	4000
Breaking current	kA	40	20	40		40 31.5	50 40
AC test voltage	kV	160	185	230	275	325	395/460 460/530
Impulse test voltage – BIL	kV	350	450	550	650	750	950/1050 1050/1200
Altitude above sea level	m	≤ 1000		≤ 1000		≤ 1000	
Max air temperature	°C	+ 40 ⁽¹⁾		+ 40 ⁽¹⁾		+ 40 ⁽¹⁾	
Min air temperature	°C	- 40 ⁽¹⁾	- 30 ⁽¹⁾	- 30 ⁽¹⁾		- 25 ⁽¹⁾	
Relative humidity	%	100		100		100	
Wind pressure	Pa	700		700		700	
Sun radiation	W/m ²	≤ 1000		≤ 1000		≤ 1000	
Earthquake (IEC 1166)	g	0.5		0.5		0.5	
Degree of protection (IEC 60529)	IP	44 ⁽²⁾		44 ⁽²⁾		44 ⁽²⁾	
Pollution level (IEC 60815)		III Heavy ⁽³⁾		IV Very Heavy		IV Very Heavy	

⁽¹⁾ Different temperatures on request.

⁽²⁾ Different degree on request.

⁽³⁾ Level IV (very heavy) on request.

Environmental impact

PASS is environmentally friendly. It has been designed in compliance with the philosophy of the PASS project, which combines functional and reliable systems with use of highly recyclable, non-energy consuming materials with low environmental impact. When materials with different characteristics have to be used, the greatest care is taken in order to obtain good performances while limiting the impact on the environment.

The fact that several functions are integrated determines an equally evident, drastic and global reduction in the environmental impact. This is because all the materials used for the typical conventional bay (such as the steel for supports, the porcelain of the insulators, the concrete of the foundations, the copper of the conductors and the aluminium used to connect the components together, etc.) have been completely eliminated.

Global life cycle costs and impact on the environment were considered right from the very beginning, when PASS was designed. Compared to a conventional air insulated solution which implements the same functions, PASS meets the following targets:

- SF₆ reduced by 80%;
- maintenance costs reduced by 38%;
- space reduced by 70%;
- total life cycle costs less than 60%.

Compared to a conventional 5-bay H layout air insulated substation, the global life cycle cost for PASS is estimated to be more than 30% lower.

Moreover, PASS M0 has been subjected to LCA (Life Cycle Assessment), a study that covers all environmental aspects during the whole life of the product. In relation to this, the EDP (Environmental Product Declaration) provides a quantitative and assessed description of the environmental performance of PASS, viewed from a comprehensive life cycle perspective.



Complete double busbar substation with PASS M0

Life Cycle Cost

The CEI 56-13 Standards that relate to the IEC300-3 Standard act as guidelines when calculating the Life Cycle Cost (LCC) of a product.

Since 1999, ABB has also been using a calculation method that allows the cost of the entire life cycle of an installation to be evaluated (initial cost of the investment, fixed charges for management and preventive maintenance, variable costs due to corrective maintenance following faults).

People who need to compare performances and relative costs throughout the entire life cycle of the actual product, and not just the technical aspects, can better understand the philosophy of PASS: products are no longer considered as a technological end in themselves, but become part of the operating context of a process and are strongly linked to its profitability.

As an example, let's take a conventional bay installed in an HV/MV substation in an operating cement works: the cost for lack of production when the system is out of service would be about 3 times higher than the cost of installing PASS. Similarly, PASS is more reliable since it is less liable to become faulty. Moreover, it needs servicing less frequently throughout the life of the installation and maintenance work can be carried out much faster. If these features are considered in relation to the process on the load side of the installation, it is evident that PASS is able to achieve remarkably interesting financial savings.



PASS M0 double busbar

New features

Motor drive

A motor drive is a digitally controlled motor that directly moves the circuit-breaker contacts.

ABB has developed a servomotor system with digital control, able to directly drive the circuit-breaker contacts in a highly accurate and reliable way.

The number of moving parts in the drive is reduced to just one, i.e. the rotating motor shaft.

Description of main functions

Operation of the motor drive can be summarized in a few simple operations: the rotor is connected directly to the circuit-breaker drive shaft. The integrated resolver in the motor continuously monitors the rotor position.

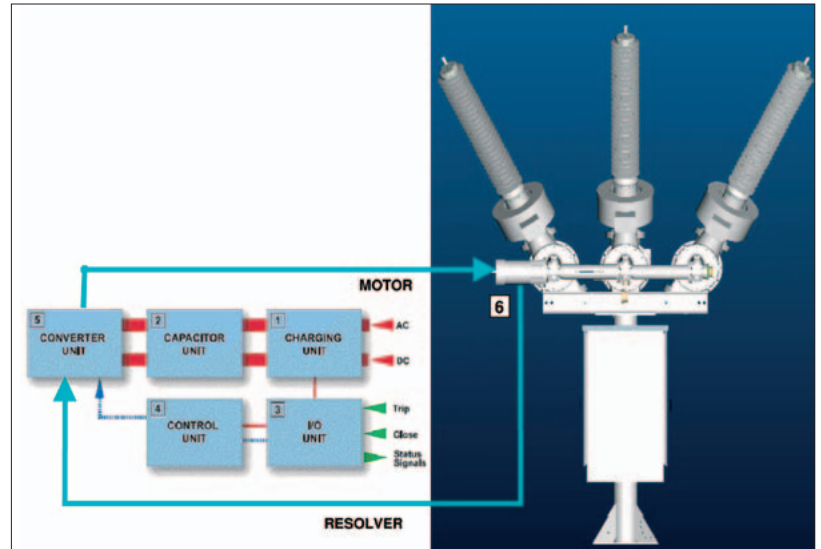
This information is fed back directly to the Control Unit. The Control Unit verifies the position measured, compares it to the position required at that moment by the pre-programmed travel curve, and sends further control signals to the Converter Unit to continue the movement of the circuit-breaker. This means the circuit-breaker contacts are precisely controlled during their entire movement by comparing the feedback data with the pre-programmed travel curve stored in the Control Unit memory.

Extensive type test

The motor drive is type tested in accordance with IEC and ANSI Standards. In view of the largely electronic nature of the motor drive, the EMC tests conducted in accordance with IEC and EN standards are of particular interest.

Simple erection

Installation and commissioning are easy. Each motor drive is pre-tested and shipped to the installation site in the form of a few pre-assembled units.



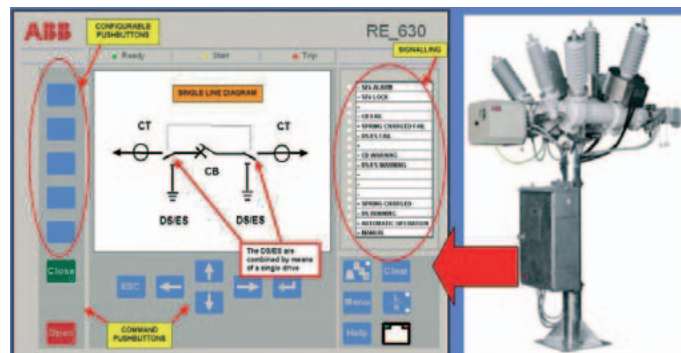
Protection and control

Integration of the protection relay inside the control cubicle

The idea is to integrate station monitoring with the circuit-breaker and disconnector control functions into one commercial high performance protection and control IED. Voltage and current signals used by the protection unit are also supplied to the control system without the need for any additional wiring.

Integration of most of the required functions into one compact unit is considered a key factor for improving cost/performance, cubicle/station layout, etc.

Communication (or links) with a remote PC (for supervision and configuration) or with a remote control room operator is based on IEC 61850 Standards.



UniWire

The UniWire cubicle is designed to replace the traditional wired logic using electromechanical components with a programmable logic controller, while maintaining the same circuit-breaker operating mechanism, DS drive, etc. The wiring diagrams are simple, the cubicle tidy and mainly consisting of standardized parts, with a lot of space for the wiring duct, terminal blocks, and customer equipment. In addition, station monitoring with the circuit-breaker and

disconnecter control functions can be integrated into one commercial high performance protection and control IED. The local panel interface is large with robust pushbuttons and bright signalling lamps for full control and status check. Each part (command, single line diagram and indication) is configurable to provide high flexibility and capability. Installation and commissioning are easy, the cubicle is delivered already configured, tested and ready to be operative.



Quality

ABB Adda designs, manufactures, installs, commissions and services equipment and Systems for SF₆ insulated High Voltage products. As part of one of the world's leading engineering companies, it helps customers to use electrical power efficiently, to increase industrial productivity and to lower environmental impact in a sustainable way.

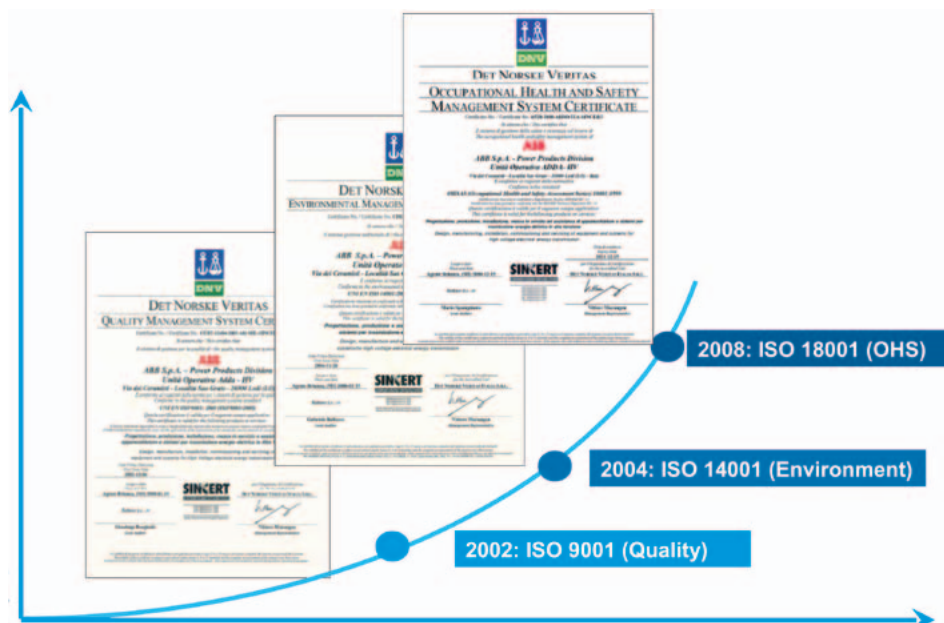
Its mission is to help customers improve their operating performance, grid reliability and productivity while saving energy and lowering environmental impact.

Our Integrated Management System, in accordance with ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:1999, states our commitment to providing Customer satisfaction in a Safe and Environmentally friendly work atmosphere for employees, customers and neighbours.

To achieve this, operational and supporting processes are constantly monitored and improved in terms of input/output data, responsibilities, description of activities and performance indicators.

Through the Quality Control Plan and in accordance with customer specifications, ABB Adda defines technical references, responsibilities and prescribed controls for each phase of production, from Incoming Quality Control to Commissioning.

By means of the Environmental Product Declarations (EPD), ABB Adda provides the necessary information about the environmental performance of the products during their whole Life Cycle, in compliance with the Standards ("Specific Product Requirements").



Activities

Incoming Control

- Supplier qualification process
- Supplier performance monitoring
- Incoming inspection
- Statistical process control
- Defect monitoring and reporting
- Involvement in preventive and corrective actions
- Periodical and systematic calibration of all instruments and equipment

Process Control

- Definition of procedures for assembling and testing activities
- Monitoring of compliancy with procedures
- Defect monitoring and reporting
- Involvement in preventive and corrective actions

Final Testing

- Testing activities, according to IEC Standards (IEC62271 for HV switchgears, IEC60044 for Instrument Transformers) or other standards (Gost, ANSI, GB) and, if this is the case, additional Customer requirements and specifications
- Issuing documentation: Routine Test Report, Factory Acceptance Test Report, Declaration of Conformity
- Quality Documentation Management for traceability

Outbound Control

- Visual check e completeness of delivery
- Monitoring of packing adequacy
- Customer Claim Management
- Involvement in preventive and corrective actions



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